

Manufacturing Process Developments for Regeneratively-cooled Channel Wall Rocket Nozzles

Paul Gradl, Will Brandsmeier

Regeneratively cooled channel wall nozzles incorporate a series of integral coolant channels to contain the coolant to maintain adequate wall temperatures and expand hot gas providing engine thrust and specific impulse. NASA has been evaluating manufacturing techniques targeting large scale channel wall nozzles to support affordability of current and future liquid rocket engine nozzles and thrust chamber assemblies. The development of these large scale manufacturing techniques focus on the liner formation, channel slotting with advanced abrasive waterjet milling techniques and closeout of the coolant channels to replace or augment other cost reduction techniques being evaluated for nozzles. NASA is developing a series of channel closeout techniques including large scale additive manufacturing laser deposition and explosively bonded closeouts. A series of subscale nozzles were completed evaluating these processes. Fabrication of mechanical test and metallography samples, in addition to subscale hardware has focused on Inconel 625, 300 series stainless, aluminum alloys as well as other candidate materials. Evaluations of these techniques are demonstrating potential for significant cost reductions for large scale nozzles and chambers. Hot fire testing is planned using these techniques in the future.